

PWHT INSTRUCTION SHEET

Field Weld Number_____ System/Line_____

Nominal Thickness_____

WPS/WTS Number_____

Heat Treatment Temperature Range_____ °F or °C

Set Point Temperature_____ °F or °C

Holding Time (based on nominal thickness)_____ hours

Heating Rate Above 600 °F (315 °C)_____ °F/hr. or °C/hr. max.

Cooling Rate Above 600 °F (315 °C)_____ °F/hr. or °C/hr. max.

Specific Instructions

Prepared:

Manager, Supervisor, or designee_____
Date

Review of Completed PWHT Documentation:

Authorized QA Representative_____
Date

INSTRUCTIONS FOR PWHT INSTRUCTION SHEET

- 1.0 A PWHT Instruction Sheet shall be completed by the LANL Facility, Project, Program Manager, or SSS designee prior to each post weld heat treatment operation and forwarded to the operator performing the PWHT. A group of field welds may be included on a single PWHT Instruction Sheet provided the holding time and heat treatment temperature range are identical and the heat treatment of the field welds will be recorded on the same strip chart.
- 2.0 The PWHT Instruction Sheet shall be completed as follows:
- 2.1 Field Weld Number and System/Line Number - List the field weld number and system / line number to be post weld heat treated.
- 2.2 Nominal Thickness - Record the nominal thickness of the field welds to be post weld heat treated. Nominal thickness values are determined in accordance with the requirements of the governing fabrication code. The following are the requirements for determining nominal thickness listed by fabrication code.
- 2.2.1 ASME Section I
- a. Full Penetration Butt and Groove Welds - The nominal thickness is the thickness of the weld, pressure retaining material, or the thinner of the members being joined, whichever is least.
 - b. Partial Penetration Butt and Groove Welds - The nominal thickness is the depth of the weld groove or preparation.
 - c. Fillet Welds - The nominal thickness is the throat thickness of the weld.
 - d. Repair Welds - The nominal thickness is the depth of the preparation or cavity to be repaired.
 - e. When nonpressure parts are welded to pressure parts, the post weld heat treatment temperature of the pressure parts shall be used.
 - f. When parts of two different P-number groups are joined by welding, the post weld heat treatment shall be that specified in the Welding Technique Sheet for the material requiring the higher post weld heat treatment temperature, except as noted in g. below.
 - g. Partial penetration and fillet welds attaching P-No. 5x tubes and pipe headers of lower P-number material may be post weld heat treated at the temperature specified for the lower P-number material provided the tubes or pipe attached to the header comply with all of the following conditions:
 - a maximum specified chromium content of 3.0%
 - a maximum nominal outside diameter of 4 in. (100 mm)
 - a maximum thickness of ½ in. (6 mm)
 - a maximum specified carbon content of 0.15%
- 2.2.2 ASME Section III
- a. Full Penetration Butt and Groove Welds - The nominal thickness is the thickness of the weld, pressure retaining material, or the thinner of the members being joined, whichever is least.
 - b. Partial Penetration Butt and Groove Welds - The nominal thickness is the depth of the weld groove or preparation.
 - c. Fillet Welds - The nominal thickness is the throat thickness of the weld.

- d. Repair Welds - The nominal thickness is the depth of the preparation or cavity to be repaired.
- e. When nonpressure parts are welded to pressure parts, the post weld heat treatment temperature of the pressure parts shall be used.
- f. When parts of two different P-number groups are joined by welding, the post weld heat treatment shall be that specified in the Welding Technique Sheet for the material requiring the higher post weld heat treatment temperature.

2.2.3 ASME Section VIII

- a. Full Penetration Butt and Groove Welds - The nominal thickness is the thickness of the weld, pressure retaining material, or when the weld joint connects parts that are of different thicknesses, the thickness to be used in applying the requirements for post weld heat treatment shall be the following:
 - the thinner of two adjacent butt-welded plates including head to shell connections.
 - the thicker of the shell or head plate in connections to intermediate heads of the type shown in Figure 1.
 - the thickness of the shell in connections to tube sheets, flat heads, covers, or similar constructions
 - the thickness of the nozzle neck at the weld in nozzle neck weld connections
 - the thickness of the shell or head plate in nozzle attachment welds, except for the type shown in Figure 2. For Figure 2, the thickness of the nozzle neck or shell or head, whichever is less.

Figure 1

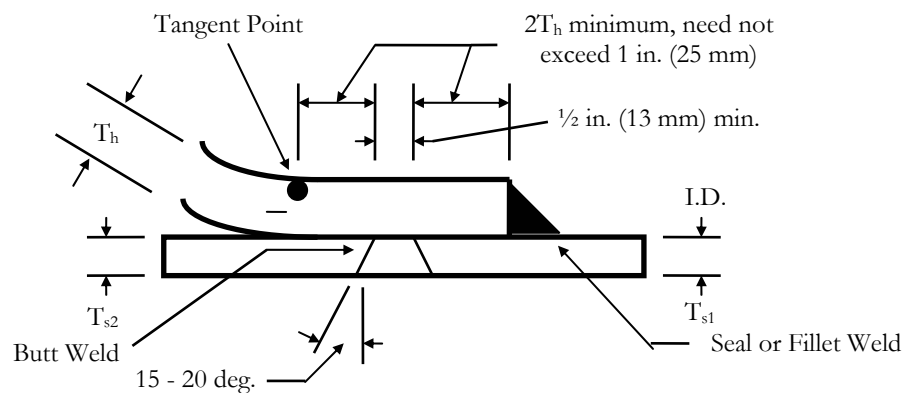


Figure 2

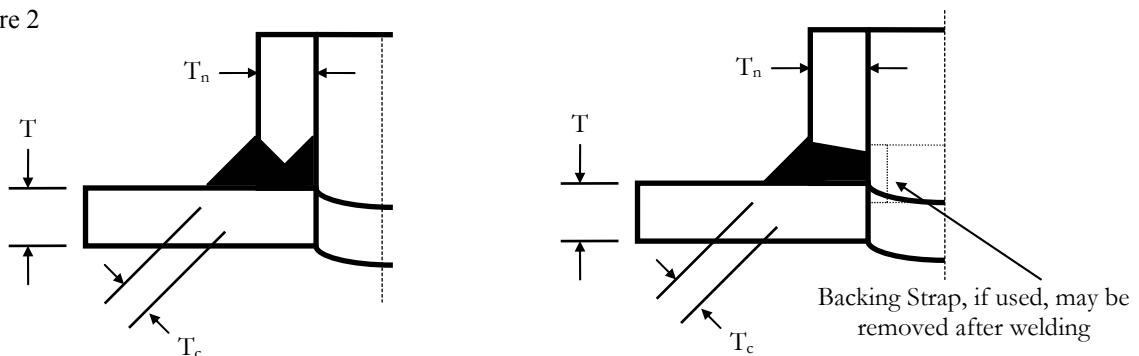
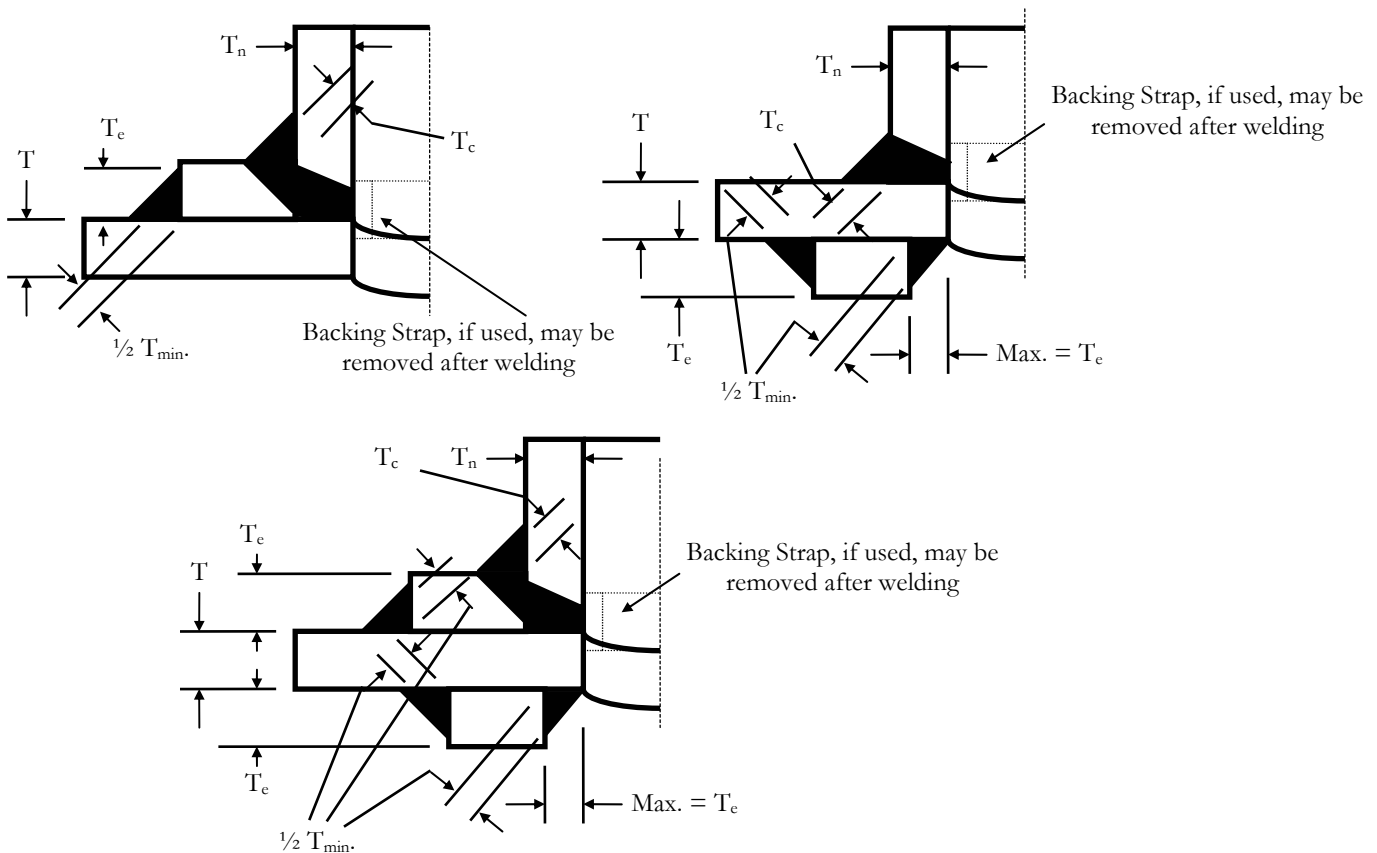


Figure 2 (continued)



- b. Partial Penetration Butt and Groove Welds - The nominal thickness is the depth of the weld groove or preparation.
- c. Fillet Welds - The nominal thickness is the throat thickness of the weld.
- d. Repair Welds - The nominal thickness is the depth of the preparation or cavity to be repaired.
- e. When nonpressure parts are welded to pressure parts, the post weld heat treatment temperature of the pressure parts shall be used.
- f. When parts of two different P-number groups are joined by welding, the post weld heat treatment shall be that specified in the Welding Technique Sheet for the material requiring the higher post weld heat treatment temperature.
- g. Vessels or parts of vessels that have been post weld heat treated shall again be post weld heat treated after repairs or alterations have been made if the welds made in such alterations or repairs require PWHT.

2.2.4 ASME B31.1

The nominal thickness is the lesser thickness of:

- the thickness of the weld
- the thicker of the materials being joined at the weld

The thickness of the weld, which is a factor in determining nominal thickness, is defined as follows:

- Groove Welds (Girth and Longitudinal) - The thicker of the two abutting ends after weld preparation, including ID machining or counterboring.
- Fillet Welds - The throat thickness of the weld.
- Partial Penetration Welds - The depth of the weld groove.
- Material Repair Welds - The depth of the cavity to be repaired.
- Branch Welds - The weld thickness is the dimension existing in the plane intersecting the longitudinal axes and is calculated as indicated for each detail. Refer to Figure 3 and calculate the weld thickness as follows.
Note: For the purpose of calculating weld thickness, T_c = the smaller of $\frac{1}{4}$ in. (6 mm) or $0.7 T_{nb}$.
- When nonpressure parts are welded to pressure parts, the post weld heat treatment temperature of the pressure parts shall be used.
- When parts of two different P-number groups are joined by welding, the post weld heat treatment shall be that specified in the Welding Technique Sheet for the material requiring the higher post weld heat treatment temperature.

Figure 3A - Weld Thickness = $T_{nb} + T_c$

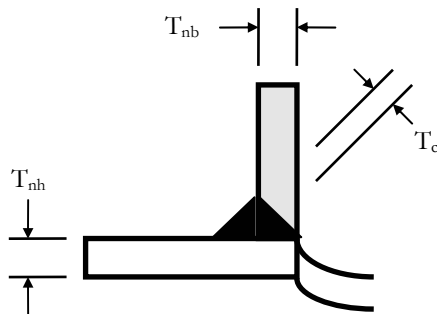


Figure 3B - Weld Thickness = $T_{nh} + T_c$

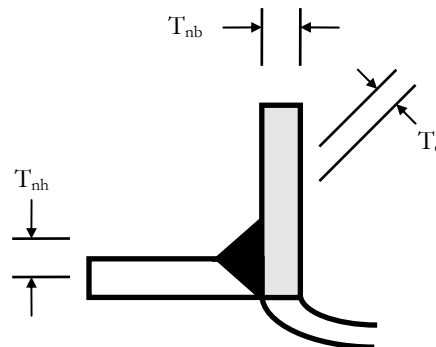


Figure 3C

Figure 3D

Weld Thickness = the greater of $T_{nr} + T_c$ or $T_{nb} + T_c$ Weld Thickness = $T_{nh} + T_r + T_c$

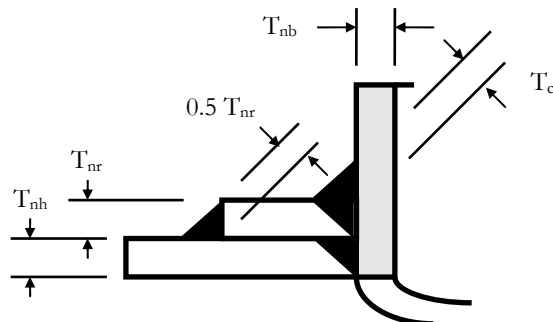
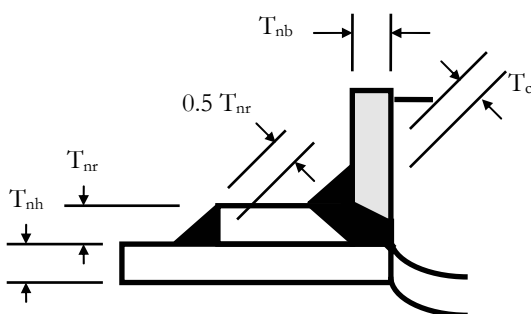
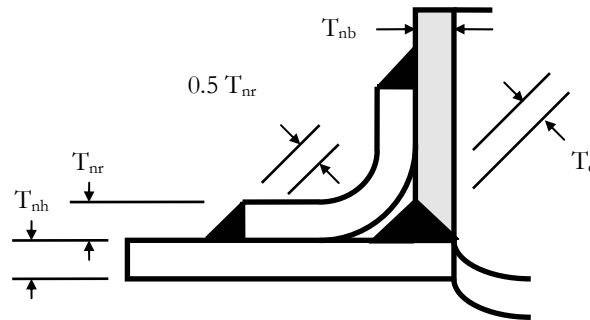


Figure 3E
Weld Thickness = $T_{nb} + T_c$



2.2.5 ASME B31.3

- a. Full Penetration Butt and Groove Welds, Partial Penetration Butt and Groove Welds, Fillet Welds, and Repair Welds - The nominal thickness is the thickness of the thicker component measured at the weld, except as noted in b. and c. as follows.
- b. In the case of branch connections, metal (other than weld metal) added as reinforcement, whether integral or attached, shall not be considered in determining heat treatment requirements. However, heat treatment is required when the thickness through the weld is greater than two times (2x) the thickness requiring heat treatment, even though the thickness of the component at the joint is less than the thickness requiring heat treatment. Thickness through the weld for branch connections is calculated as shown in Section 2.2.4, Paragraph e.
- c. In the case of fillet welds used at slip-on and socket welding flanges and connections in piping 2 in. (50 mm) and smaller, for seal welding of threaded joints in piping 2 in. (50 mm) and smaller, and for attachment of external non-pressure-containing parts such as lugs or other pipe supporting elements in all pipe sizes, heat treatment is required when the thickness through the weld is more than twice the thickness requiring heat treatment (even though the thickness of the component at the joint is less than the thickness requiring heat treatment.) However, PWHT is not required for P-1 materials when weld throat thickness is $\frac{5}{8}$ in. (16 mm) or less, regardless of base metal thickness.

- 2.3 Welding Procedure Specification / Welding Technique Sheet Number - Record the WPS / WTS number that was utilized to weld for field welds.
- 2.4 Heat Treatment Temperature Range - Record the temperature range specified for PWHT from the Welding Technique Sheet.
- 2.5 Set Point Temperature - The set point temperature should be the mean temperature of the heat treatment temperature range and should be maintained as close as possible for the length of the holding time. For PWHT equipment that has programmable controls, this set point temperature should be programmed into the controller.
- 2.6 Holding Time - Record the holding time based on the nominal thickness and the values listed on the Welding Technique Sheet.
- 2.7 Heating Rate Above 600 °F (315 °C) - Record the heat-up rate from Paragraph 5.12 of the PWHT Procedure.
- 2.8 Cooling Rate Above 600 °F (315 °C) - Record the cool-down rate from Paragraph 5.12 of the PWHT Procedure.
- 2.9 Special Instructions - List any special instructions, e.g. width of band to be heated, what temperature to remove insulation, which equipment to use.

- 2.10 The LANL Project Manager or designee shall sign and date the completed PWHT Instruction Sheet and forward it to the PWHT operator.
- 2.11.1 When the PWHT operation is finished, the LANL project Manager or designee shall review the strip recorder chart to ensure that the PWHT operation was performed in accordance with the PWHT Instruction Sheet and sign the PWHT Instruction Sheet to indicate approval that PWHT was performed correctly.
- 2.2.6 AWS D 1.1
To be developed. Contact LANL FWO WPA for requirements.
- 2.2.7 ANSI-B31
To be developed. Contact LANL FWO WPA for requirements.